Claims

1. A functional element, comprising a carrier with a surface and at least one microstructure arranged on the carrier surface, characterized in that the microstructure consists of individual components in the form of nanoparticles, which have molecule-specific recognition sites enabling the addressability of the microstructure.

2. The functional element as claimed in claim 1, wherein the microstructure covers a portion of the carrier surface and at least one of the area/length parameters of the covered portion of the carrier surface is smaller than 999 µm and at least 10 nm.

3. The functional element as claimed in claim 1 or 2, wherein the carrier and/or the surface of the carrier consists of a metal, metal oxide, polymer, semiconductor material, glass and/or ceramic.

4. The functional element as claimed in one of the claims 1 to 3, wherein the surface of the carrier is planar.

5. The functional element as claimed in one of the claims 1 to 3, wherein the surface of the carrier is pre-structured.

6. The functional element as claimed in one of the claims 1 to 5, wherein the surface of the carrier has a layer of a chemical compound that prevents nonspecific attachment of biological molecules to the carrier surface.

7. The functional element as claimed in one of the claims 1 to 6, wherein a layer of a bonding agent is arranged between the carrier surface and the microstructure.

8. The functional element as claimed in claim 7, wherein the bonding agent is a polymer with charged or uncharged chemically reactive groups.

9. The functional element as claimed in claim 8, wherein the polymer is a hydrogel.

10. The functional element as claimed in claim 7, wherein the bonding agent is a plasma layer with charged or uncharged chemically reactive groups.

11. The functional element as claimed in claim 7, wherein the bonding agent is a self-assembled monolayer based on silane or thiol.

12. The functional element as claimed in one of the claims 7 to 11, wherein the bonding agent is switchable by altering the pH value, the ion concentration or the temperature.

13. The functional element as claimed in one of the claims 1 to 12, wherein the nanoparticles comprise a core and a surface that has the molecule-specific recognition sites.

14. The functional element as claimed in claim 13, wherein one or more biologically active molecules are bound to the molecule-specific recognition sites.

15. The functional element as claimed in claim 14, wherein the biologically active molecules are bound covalently and/or non-covalently.

16. The functional element as claimed in claim 14 or 15, wherein the molecules are bound preserving their biological activity.

17. The functional element as claimed in one of the claims 14 to 16, wherein the bound molecules are proteins, nucleic acids, PNA molecules or fragments thereof.

18. The functional element as claimed in claim 16, wherein the proteins are antibodies, antigens, enzymes, cytokines or receptors.

19. The functional element as claimed in one of the claims 13 to 18, wherein the molecule-specific recognition sites comprise one or more first functional groups and the bound molecules comprise complementary second functional groups that bind the first functional groups.

20. The functional element as claimed in claim 19, wherein the first functional groups and the complementary second functional groups that bind the first functional groups are selected from the group comprising active ester, alkyl ketone group, aldehyde group, amino group, carboxy group, epoxy group, maleinimide group, hydrazine group, hydrazide group, thiol group, thioester group, oligohistidine group, Strep-tag I, Strep-tag II, desthiobiotin, biotin, chitin, chitin derivatives, chitin

binding domain, metal chelate complex, streptavidin, streptactin, avidin and neutravidin.

21. The functional element as claimed in claim 19 or 20, wherein the first and the second functional groups are produced by molecular imprinting.

22. The functional element as claimed in one of the claims 19 to 21, wherein the first functional groups are a component part of a spacer or are bound via spacers to the surface of the nanoparticles.

23. The functional element as claimed in one of the claims 19 to 21, wherein the complementary second functional groups are a component part of a spacer or are bound via spacers to the molecules.

24. The functional element as claimed in one of the claims 13 to 23, wherein the core of the nanoparticles consists of or contains an organic material.

25. The functional element as claimed in claim 24, wherein the organic material is an organic polymer.

26. The functional element as claimed in claim 24 or 25, wherein the organic polymer is polypropylene, polystyrene, polyacrylate or a mixture thereof.

27. The functional element as claimed in one of the claims 13 to 23, wherein the core consists of or contains an inorganic material.

28. The functional element as claimed in claim 27, wherein the inorganic material is a metal such as Au, Ag or

Ni, silicon, SiO_2, SiO, a silicate, Al_2O_3, $SiO_2 \cdot Al_2O_3$, Fe_2O_3, Ag_2O, TiO_2, ZrO_2, Zr_2O_3, Ta_2O_5, zeolite, glass, indium-tin oxide, hydroxylapatite, a Q-Dot or a mixture thereof.

29. The functional element as claimed in one of the claims 24 to 28, wherein the core has a size from 5 nm to 500 nm.

30. The functional element as claimed in one of the claims 24 to 29, wherein the core has at least one additional function.

31. The functional element as claimed in claim 30, wherein the additional function is anchored in the core and is a fluorescence marker, a UV/Vis marker, a superparamagnetic function, a ferromagnetic function and/or a radioactive marker.

32. The functional element as claimed in claim 30, wherein the surface of the core is modified with an organic or inorganic layer containing the first functional groups, which has a fluorescence marker, a UV/Vis marker, a superparamagnetic function, a ferromagnetic function and/or a radioactive marker.

33. The functional element as claimed in one of the claims 30 to 32, wherein the surface of the core has a chemical compound, which serves for steric stabilization and/or for preventing a change of conformation of the immobilized molecules and/or for preventing the attachment of a further biologically active compound to the core.

34. The functional element as claimed in claim 33, wherein the chemical compound is a polyethylene glycol, an oligoethylene glycol, dextran or a mixture thereof.

35. The functional element as claimed in one of the preceding claims, wherein the bound molecules have a marker.

36. The functional element as claimed in one of the preceding claims, wherein further molecules are bound to the bound molecules.

37. The functional element as claimed in one of the preceding claims, wherein the microstructure consists of a nanoparticle layer.

38. The functional element as claimed in one of the preceding claims, wherein the microstructure consists of several nanoparticle layers.

39. The functional element as claimed in one of the preceding claims, wherein several microstructures, which consist of nanoparticles with different molecule-specific recognition sites, are arranged on the carrier surface.

40. The functional element as claimed in claim 39, wherein various molecules are bound to the microstructures.

41. The functional element as claimed in one of the claims 1 to 40, obtainable by applying one or more microstructures to the carrier surface using a ring/pin printer.

42. The functional element as claimed in one of the claims 1 to 40, obtainable by applying one or more

microstructures to the carrier surface using a lithographic process.

43. The functional element as claimed in claim 42, wherein the lithographic process is photolithography.

44. The functional element as claimed in claim 42, wherein the lithographic process is micropen lithography.

45. The functional element as claimed in one of the claims 1 to 40, obtainable by applying one or more microstructures to the carrier surface using an inkjet process.

46. The functional element as claimed in one of the claims 1 to 40, obtainable by applying one or more microstructures using a microcontact printing process.

47. A method for the production of a functional element as claimed in one of the preceding claims, wherein at least one layer of a bonding agent and then at least one microstructure consisting of nanoparticles with molecule-specific recognition sites are applied to the surface of a carrier.

48. The method as claimed in claim 47, wherein the surface of the carrier is cleaned and/or activated before applying the layer of bonding agent.

49. The method as claimed in claim 48, wherein the carrier surface is activated chemically.

50. The method as claimed in claim 49, wherein the carrier surface is provided with charges.

51. The method as claimed in claim 49 or 50, wherein the carrier surface is activated after applying a primer.

52. The method as claimed in claim 49 or 50, wherein a self-assembly layer is applied to the carrier surface.

53. The method as claimed in claim 48, wherein the carrier surface is activated by means of a plasma.

54. The method as claimed in one of the claims 47 to 53, wherein a layer of bonding agent defined with respect to shape and area is applied to the carrier surface and the carrier is then dipped into a nanoparticle suspension, so that a microstructure that is defined with respect to shape and area is produced through adherence of the nanoparticles to the applied layer of bonding agent.

55. The method as claimed in claim 54, wherein the layer of bonding agent defined with respect to shape and area is applied by means of a ring/pin printer, a lithographic process, an inkjet process or a microcontact printing process.

56. The method as claimed in one of the claims 47 to 55, wherein the carrier is dipped into a suspension or solution of the bonding agent, so that a layer of bonding agent covering the whole carrier surface is produced, and then the nanoparticles are applied in such a way that a microstructure defined with respect to shape and area is produced.

57. The method as claimed in claim 56, wherein the microstructure defined with respect to shape and area is applied by means of a ring/pin printer, a lithographic process, an inkjet process or a microcontact printing process.

58. The method as claimed in one of the claims 47 to 57, wherein the bonding agent and the nanoparticles are applied to the carrier surface several times.

59. The method as claimed in one of the claims 47 to 58, wherein biologically active molecules are bound to the molecule-specific recognition sites of the nanoparticles before the nanoparticles are applied.

60. The method as claimed in one of the claims 47 to 58, wherein biologically active molecules are bound to the molecule-specific recognition sites of the nanoparticles after application of the nanoparticles.

61. The method as claimed in one of the claims 47 to 58, wherein biologically active molecules are bound to the molecule-specific recognition sites of the nanoparticles before and after application of the nanoparticles.

62. The method as claimed in one of the claims 59 to 61, wherein the binding of the biologically active molecules to the molecule-specific recognition sites of the nanoparticles is effected by bringing the molecule-specific recognition sites of the nanoparticles, which have first functional groups, into contact with the molecules that have

complementary second functional groups that bind the first functional groups, in such a way that covalent and/or non-covalent bonds are effected between the functional groups of the molecule-specific recognition sites and the molecules.

63. The method as claimed in claim 62, wherein the first functional groups and the complementary second functional groups that bind the first functional groups are selected from the group comprising active ester, alkyl ketone group, aldehyde group, amino group, carboxy group, epoxy group, maleinimide group, hydrazine group, hydrazide group, thiol group, thioester group, oligohistidine group, Strep-tag I, Strep-tag II, desthiobiotin, biotin, chitin, chitin derivatives, chitin binding domain, metal chelate complex, streptavidin, streptactin, avidin and neutravidin.

64. The method as claimed in one of the claims 59 to 63, wherein the biologically active molecules are bound while retaining their biological activity.

65. The method as claimed in one of the claims 59 to 64, wherein the molecules are proteins, antigens, nucleic acids, PNA molecules or fragments thereof.

66. A use of a functional element as claimed in one of the claims 1 to 46 or of a functional element produced by a method as claimed in one of the claims 47 to 65 for carrying out a method of detection.

67. The use as claimed in claim 66, wherein the method of detection is MALDI mass spectroscopy, fluorescence or UV-

Vis spectroscopy, fluorescence or light microscopy, waveguide spectroscopy, impedance spectroscopy or some other electrical method.

68. The use of a functional element as claimed in one of the claims 1 to 46 or of a functional element produced by a method as claimed in one of the claims 47 to 65 for controlling cellular adhesion or cellular growth.

69. The use of a functional element as claimed in one of the claims 1 to 46 or of a functional element produced by a method as claimed in one of the claims 47 to 65 for the development of pharmaceutical preparations.

70. The use of a functional element as claimed in one of the claims 1 to 46 or of a functional element produced by a method as claimed in one of the claims 47 to 65 for analysis of the effects and/or side-effects of pharmaceutical preparations.

71. The use of a functional element as claimed in one of the claims 1 to 46 or of a functional element produced by a method as claimed in one of the claims 47 to 65 for the diagnosis of diseases.

72. The use as claimed in claim 71, wherein the functional element is used for identifying pathogens.

73. The use as claimed in claim 71, wherein the functional element is used for identifying mutated genes in a human being or an animal.

74. The use of a functional element as claimed in one of the claims 1 to 46 or of a functional element produced by a method as claimed in one of the claims 47 to 65 for analysis of the microbiological contamination of samples.

75. The use as claimed in claim 74, wherein the sample is a water sample or a soil sample.

76. The use as claimed in claim 74, wherein the sample is obtained from the foodstuff or animal feed.

77. The use of a functional element as claimed in one of the claims 1 to 46 or of a functional element produced by a method as claimed in one of the claims 47 to 65 as an electronic component in a biocomputer.